



U.S. Department
of Transportation

Federal Aviation
Administration

Advisory Circular

Subject: Change 12 to STANDARDS FOR **SPECIFYING**
CONSTRUCTION OF AIRPORTS

Date: 2/22/99

Initiated by: AAS-200

AC No: 150/5370-10A
change: 12

1. **PURPOSE.** ITEM P-620 RUNWAY AND **TAXIWAY** PAINTING has been revised to clarify AIP and PFC **funded** project requirements for drop-on glass beads in paint to improve conspicuity and **friction** characteristics, make minor technical corrections, and add tolerances to dimensions and spacings of markings.

2. **PRINCIPAL CHANGES.** The following principal changes have been made:

a. The note to the Engineer for paragraph 620-2.2 PAINT has been revised to correct the proportions of red and white paint required to achieve a pink paint.

b. Paragraph 620-2.2a WATERBORNE has been revised to indicate that paint shall meet the requirements of **TT-P-1952D**.

c. Paragraph 620-2.2d SOLVENT-BASE has been revised to indicate that paint shall meet the requirements of Commercial Item Description (CID) A-A-2886A **Type** I or Type II.

d. The note to the Engineer for paragraph 620-2.3 REFLECTIVE MEDIA has been revised to read "The Engineer shall specify: **Type** I--gradation A, or Type III."

e. The note to the Engineer for paragraph 620-3.1 WEATHER LIMITATIONS has been revised to allow the Engineer to specify minimum and maximum **surface** temperatures for painting based on manufacturers recommendations.

f. A note to the Engineer has been added to paragraph 620-3.4 LAYOUT OF MARKINGS to clarify the locations of markings to receive glass beads to improve conspicuity and improve **friction** characteristics

g. Paragraph 620-3.5 APPLICATION has been revised to add dimension and spacing tolerances and the note to the Engineer has been revised to indicate glass beads are not **required** for temporary markings.

The change number and date are shown at the top of each page.

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ITEM P-620 RUNWAY AND TAXIWAY PAINTING

DESCRIPTION

620-1.1 This item shall consist of the painting of numbers, markings, and stripes on the surface of runways, taxiways, and aprons, in accordance with these specifications and at the locations shown on the plans, or as directed by the Engineer.

MATERIALS

620-2.1 MATERIALS ACCEPTANCE. The Contractor shall furnish manufacturer's certified test reports for materials shipped to the project. The certified test reports shall include a statement that the materials meet the specification requirements. The reports can be used for material acceptance or the Engineer may perform verification testing. The reports shall not be interpreted as a basis for payment. The Contractor shall notify the Engineer upon arrival of a shipment of materials to the site.

620-2.2 PAINT. Paint shall be [Waterborne, Epoxy, Methacrylate, or Solvent-base] in accordance with the requirements of paragraph 620-2.2[]. Paint shall be furnished in [] in accordance with Federal Standard No 595.

The Engineer shall specify paint type(s) and appropriate paragraph number(s). The Engineer shall insert the colors to be used on a project from the following list:

White - 37925

Yellow - 33538 or 33655

Pink - 1 part Red - 31136 to 2 parts White - 37925

Red - 31136

Black - 37038

Waterborne or solvent base black paint **should** be used to outline a border at least 6 inches (150 mm) wide around markings on all **light** colored pavements.

For **TT-P-1952D** and A-A-2886A paints, the Engineer **shall** specify the type required.

Type I is intended for those locations where slower tracking is not an inconvenience.

Type II is intended for **striping** locations where faster **curing** is desirable.

Type III (A-A-2886A only) - Premixed ReflectORIZED, Standard Dry for temporary markings.

a. WATERBORNE. Paint shall meet the requirements of Federal Specification TT-P-1952D, [Type I or Type II].

b. EPOXY. Paint shall be a two component, minimum 99 percent solids type system conforming to the following:

(1) **Pigments.** Component A. Percent by weight.

(a) **White:**

Titanium Dioxide, ASTM D 476, type II shall be 18 percent minimum
(16.5 percent minimum at 100 percent purity).

(b) **Yellow and Colors:**

Titanium Dioxide, ASTM D 476, type II shall be 14 to 17 percent.
Organic yellow, other colors, and tinting as required to meet color standard.
Epoxy resin shall be 75 to 79 percent.

(2) **Epoxy Content.** Component A. The weight per epoxy equivalent, when tested in accordance with ASTM D 1652 shall be the manufacturer's target plus or minus 50.

(3) **Amine Number.** Component B. When tested in accordance with ASTM D 2074 shall be the manufacturer's target plus or minus 50.

(4) **Prohibited Materials.** The manufacturer shall certify that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen, as defined in 29 CFR 19.10.1200.

(5) **Daylight Directional Reflectance:**

(a) **White:** The daylight directional reflectance of the white paint shall not be less than 75 percent (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141, Method 6121.

(b) **Yellow:** The daylight directional reflectance of the yellow paint shall not be less than 38 percent (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141. The x and y values shall be consistent with the Federal Hegman yellow color standard chart for traffic yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	x	.470	x	.479	x	.501
y	.438	y	.455	y	.428	y	.452

(6) **Accelerated Weathering.**

(a) **Sample Preparation.** Apply the paint at a wet film thickness of 0.013 inch (0.33 mm) to four 3 by 6 inch (8 by 15 cm) **aluminum** panels prepared as described in Federal Test Method Standard No. 141, Method 20.13. Air dry the sample 48 hours under standard conditions.

(b) **Testing Conditions.** Test in accordance with ASTM G 53 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating 4 hour W exposure at 60 degree C, and 4 hours condensate exposure at 40 degrees C.

(c) **Evaluation.** Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph 620-2.2b(5) above. Evaluate for conformance with the color requirements.

(7) **Volatile Organic Content.** Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(8) **Dry Opacity.** Use Procedure B, Method B of Method 412.1 of Federal Test Method Standard No. 141. The wet film thickness shall be 0.015 inch (0.12 mm). The minimum opacity for white and colors shall be 0.92.

(9) **Abrasion Resistance.** Subject the panels prepared in paragraph 620-2.2b(6) to the abrasion test in accordance with ASTM D 968, Method A, except that the inside diameter of the metal guide tube shall be **from** 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters of unused sand shall be used for each test panel. The test shall be run on two test panels. [Note: five liters of sand weighs 17.5 lb. (7.94 kg).] Both baked and weathered paint films shall require not less than 150 liters of sand for the removal of the paint films.

(10) **Hardness, Shore.** Hardness shall be at least 80 when tested in accordance with ASTM D 2240.

c. METHACRYLATE. Paint shall be a two component, minimum 99 percent solids-type system conforming to the following:

(1) **Pigments.** Component A. Percent by weight.

(a) **White:**

Titanium Dioxide, ASTM D 476, type II shall be 6 percent minimum.
Methacrylate resin shall be 18 percent minimum.

(b) Yellow and Colors:

Titanium Dioxide, ASTM D 476, type II shall be 6 percent minimum.

Organic yellow, other colors, and tinting as required to meet color standard.

Methacrylate resin shall be 18 percent minimum.

(2) Prohibited Materials. The manufacturer shall **certify** that the product does not contain mercury, lead, hexavalent chromium, halogenated solvents, nor any carcinogen, as defined in 29 CFR 1910.1200.

(3) Daylight Directional Reflectance:

(a) White: The daylight directional reflectance of the white paint shall not be less than 80 percent (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141, Method 6121.

(b) Yellow: The daylight directional reflectance of the yellow paint shall not be less than 55 percent (relative to magnesium oxide), when tested in accordance with Federal Test Method Standard No. 141. The x and y values shall be consistent with the Federal Hegman yellow color standard chart for **traffic** yellow standard 33538, or shall be consistent with the tolerance listed below:

x	.462	x	.470	x	.479	x	.501
y	.438	y	.455	y	.428	y	.452

(4) Accelerated Weathering.

(a) Sample Preparation. Apply the paint at a wet film thickness of 0.013 inch (0.33 mm) to four 3 by 6 inch (8 by 15 cm) aluminum panels prepared as described in Method 20 13 of Federal Test Method Standard No. 14 1. Air dry the sample 48 hours under standard conditions.

(b) Testing Conditions. Test in accordance with ASTM G 53 using both Ultra Violet (UV-B) Light and condensate exposure, 72 hours total, alternating 4 hour UV exposure at 60 degree C, and 4 hours condensate exposure at 40 degrees C.

(c) Evaluation. Remove the samples and condition for 24 hours under standard conditions. Determine the directional reflectance and color match using the procedures in paragraph **620-2.2c(3)** above. Evaluate for conformance with the color requirements.

(5) Volatile Organic Content. Determine the volatile organic content in accordance with 40 CFR Part 60 Appendix A, Method 24.

(6) Dry Opacity. Use Procedure B, Method B of Method 4121 of Federal Test Method Standard No. 141. The wet film thickness shall be 0.015 inch (0.12 mm). The minimum opacity for white and colors shall be 0.92.

(7) Abrasion Resistance. Subject the panels prepared in paragraph **620-2.2c(4)** to the abrasion test in accordance with ASTM D 968, Method A, except that the inside diameter of the metal guide tube shall be **from** 0.747 to 0.750 inch (18.97 to 19.05 mm). Five liters of unused sand shall be used for each test panel. The test shall be run on two test panels. [Note: five liters of sand weighs 17.5 lb. (7.94 kg).] Both baked and weathered paint films shall require not less than 150 liters of sand for the removal of the paint **films**.

(8) Hardness, Shore. Hardness shall be at least 80 when tested in accordance with ASTM D 2240.

d. SOLVENT-BASE. Paint shall meet the requirements of Federal Specification [A-A-2886A Type I or Type II].

620-2.3 REFLECTIVE MEDIA. Glass beads shall meet the requirements of Fed. Spec. TT-B-1325, []. Glass beads shall be treated with adhesion promoting and/or flotation coatings as specified by the manufacturer of the paint.

Glass beads improve the friction characteristics of all markings. The Engineer shall specify:

Type I-gradation A, or Type III. The Engineer should consult with the paint manufacturer on the use of adhesion, flow promoting, and/or flotation additives.

[620-2.4 SILICA SAND. Silica sand shall be foundry grade silica sand composed of at least 99.5 percent silicon dioxide when tested in accordance with ASTM C 146. The gradation of the silica sand shall meet the paint manufacturer's recommendations and shall approximate a 50/60 graded sand when tested in accordance with ASTM C-136.1

Silica sand improves the friction characteristics of all markings and may reduce the rate of accumulation of rubber deposits. It is generally not practical to use both drop-on beads and sand in the paint. NOTES: 1. Where glass beads are required, sand is not necessary. 2. Where glass beads are not required for waterborne and solvent-based paints, sand is optional. 3. All epoxy and methacrylate paints require the addition of glass beads or sand to improve friction characteristics. The Engineer shall specify sand where glass beads are not required in all epoxy and methacrylate paints.

CONSTRUCTION METHODS

620-3.1 WEATHER LIMITATIONS. The painting shall be performed only when the surface is dry and when the surface temperature is at least 45 degrees F (7 degrees C) and rising and the pavement surface temperature is at least 5 degrees F (2.7 degrees C) above the dew point. [Painting operations shall be discontinued when the surface temperature exceeds [] degrees F ([] degrees C.)

The Engineer may specify minimum and maximum surface temperatures based on paint manufacturer's recommendations.

620-3.2 EQUIPMENT. Equipment shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, a bead and/or silica sand dispensing machine, and such auxiliary hand-painting equipment as may be necessary to satisfactorily complete the job.

The mechanical marker shall be an atomizing spray-type marking machine suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall apply markings of uniform cross sections and clear-cut edges without running or spattering and without over spray.

620-3.3 PREPARATION OF SURFACE. Immediately before application of the paint, the surface shall be dry and free from dirt, grease, oil, laitance, or other foreign material that would reduce the bond between the paint and the pavement. The area to be painted shall be cleaned by sweeping and blowing or by other methods as required to remove all dirt, laitance, and loose materials. [Paint shall not be applied to Portland cement concrete pavement until the areas to be painted are clean of curing material. Sandblasting or high-pressure water shall be used to remove curing materials.]

The Engineer should specify any additional surface preparation required and should specify the type of surface preparation to be used when existing markings interfere with or would cause adhesion problems with new markings.

620-3.4 LAYOUT OF MARKINGS. The proposed markings shall be laid out in advance of the paint application. The locations of markings to receive glass beads shall be shown on the plans. [The locations of markings to receive silica sand shall be shown on the plans.]

Glass beads improve conspicuity and the friction characteristics of markings. When markings are part of an AIP or PFC funded project, at a **minimum**, the Engineer shall indicate the following locations to receive glass beads:

1. All runway and **taxiway** holding position markings.
2. Runway threshold marking.
3. Runway threshold bar.
4. Runway **aiming** point marking.
5. Runway designation **marking**.
6. Runway touchdown zone markings.
7. **Runway** centerline marking.
8. **Taxiway** centerline marking.
9. Geographical position marking.
10. Surface painted signs.

In addition to the minimum list above, the following locations are recommended to receive glass beads:

11. Runway side stripes,
12. **Taxiway** edge markings,
13. Non-movement Area boundary markings,
14. Displaced threshold **markings**, and
15. Demarcation bar.

620-3.5 APPLICATION. Paint shall be applied at the locations and to the dimensions and spacing shown on the plans. Paint shall not be applied until the layout and condition of the surface has been approved by the Engineer. The edges of the markings shall not vary from a straight line more than 1/2 inch (12 mm) in 50 feet (15 m) and marking dimensions and spacings shall be within the following tolerances:

Dimension and Spacing	Tolerance
36 inches (910 mm) or less	+/- 1/2 inch (12 mm)
greater than 36 inches to 6 feet (910 mm to 1.85 m)	+/- 1 inch (25 mm)
greater than 6 feet to 60 feet (1.85 m to 18.3 m)	+/- 2 inches (51 mm)
greater than 60 feet (18.3 m)	+/- 3 inches (76 mm)

The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine at the rate(s) shown in Table 1. The addition of thinner will not be permitted. A period of [] shall elapse between placement of a bituminous surface course or seal coat and application of the paint.

TABLE 1. APPLICATION RATES FOR PAINT, GLASS BEADS, AND SILICA SAND

Paint Type	Paint Square feet per gallon, ft^2/gal (Square meters per liter, m^2/l)	Glass Beads, Type I, Gradation A Pounds per gallon of paint--lb./gal. (Kilograms per liter of paint--kg/l)	Glass Beads, Type III Pounds per gallon of paint--lb./gal. (Kilograms per liter of paint--kg/l)	Silica Sand Pounds per gallon of paint--lb./gal. (Kilograms per liter of paint--kg/l)
*	*	*	*	*

The Engineer shall specify the application rates for paint, glass beads, and silica sand from the following table.

APPLICATION RATES FOR PAINT, GLASS BEADS, AND SILICA SAND FOR TABLE 1

Paint Type	Paint Square feet per gallon, ft^2/gal (Square meters per liter, m^2/l)	Glass Beads, Type I, Gradation A Pounds per gallon of paint--lb./gal. (Kilograms Per liter of paint--kg/l)	Glass Beads, Type III Pounds per gallon of paint--lb./gal. (Kilograms per liter of paint--kg/l)	Silica Sand Pounds per gallon of paint--lb./gal. (Kilograms per liter of paint--kg/l)
Waterborne	115 ft^2/gal . maximum (2.8 m^2/l)	7 lb./gal. minimum (0.85 kg/l)	12 lb./gal. minimum (1.45 kg/l)	4 lb./gal. minimum (0.5 kg/l)
Solvent Base	115 ft^2/gal . maximum (2.8 m^2/l)	7 lb./gal. minimum (0.85 kg/l)	12 lb./gal. minimum (1.45 kg/l)	4 lb./gal. minimum (0.5 kg/l)
Epoxy	90 ft^2/gal . maximum (2.2 m^2/l)	15 lb./gal. minimum (1.8 kg/l)	24 lb./gal. minimum (2.9 kg/l)	8 lb./gal. minimum (1.0 kg/l)
Methacrylate	45 ft^2/gal . maximum (1.1 m^2/l)	15 lb./gal. minimum (1.8 kg/l)	24 lb./gal. minimum (2.9 kg/l)	8 lb./gal. minimum (1.0 kg/l)

The Engineer shall specify the time period in order to allow adequate curing of the pavement surface. The Engineer should contact the paint manufacturer to determine the wait period.

Due to the increased surface area to cover, the following should be substituted when painting P-402 Porous Friction Course with waterborne or solvent based paints: "The paint shall be mixed in accordance with the manufacturer's instructions and applied to the pavement with a marking machine from two directions at 75 percent of the rate(s) (e.g. rate/0.75 for paint, 0.75 x rate for beads and sand)) shown in Table 1 from each direction."

Markings may be required before paving operations are complete. The Engineer may wish to specify waterborne or solvent-based materials for temporary markings at 30-50 percent of the specified application rates (e.g. rate/0.50). No glass beads or sand are required for temporary markings. A-A-2886A, Type III may be used for temporary markings when reflectorized temporary markings are desired

Glass beads shall be distributed upon the marked areas at the locations shown on the plans to receive glass beads immediately after application of the paint. A dispenser shall be furnished which is properly designed for attachment to the marking machine and suitable for dispensing glass beads. Glass beads shall be applied at the rate(s) shown in Table 1. Glass beads shall not be applied to black paint. [Silica sand shall be distributed upon the marked areas at the locations shown on the plans to receive silica sand immediately after application of the paint. A dispenser shall be furnished which is properly designed for attachment to the marking machine and suitable for dispensing silica sand Silica sand shall be applied at the rate(s) shown in Table 1. Glass beads [and silica sand] shall adhere to the cured paint or all marking operations shall cease until corrections are made.

All emptied containers shall be returned to the paint storage area for checking by the Engineer. The containers shall not be removed from the airport or destroyed until authorized by the Engineer.

620-3.6 **PROTECTION.** After application of the paint, all markings shall be protected from damage until the paint is dry. All surfaces shall be protected from excess moisture and/or rain and **from** disfiguration by spatter, splashes, spillage, or drippings of paint.

METHOD OF MEASUREMENT

620-4.1 The quantity of runway and **taxiway** markings to be paid for shall be [the number of square feet (square meters) of painting [, the number of pounds (kilograms of **silica** sand,] and the number of pounds (**kilograms**) of reflective media] [one complete item in place] performed in accordance with the specifications and accepted by the Engineer.

BASIS OF PAYMENT

620-5.1 Payment shall be made at the respective contract [price per square foot (square meter)] [**lump sum price**] for runway and **taxiway** painting [, [price per **pound (kilogram)**] [**lump sum price**] for **silica** sand,] and [price **per pound (kilogram)**] [**lump sum price**] for reflective media. This price shall be full compensation for furnishing all materials and for all labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under:

Item P-620-5.1-1	Runway and Taxiway Painting [per square foot (square meter)] [lump sum]
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 The Engineer should include a pay item for each paint **material** specified.

Item P-620-5.1-2	Reflective Media [per pound (kilogram)] [lump sum]
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Item P-620-5.1-3	Silica Sand [per pound (kilogram)] [lump sum]
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TESTING REQUIREMENTS

ASTM C-146	Chemical Analysis of Glass Sand
ASTM C 371	Wire-Cloth Sieve Analysis of Nonplastic Ceramic Powders
ASTMD92	Test Method for Flash and Fire Points by Cleveland Open Cup
ASTM D 711	No-Pick-Up Time of Traffic Paint
ASTM D 968	Standard Test Methods for Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 1652	Test Method for Epoxy Content of Epoxy Resins
ASTM D 2074	Test Method for Total Primary, Secondary, and Tertiary Amine Values of Fatty Amines by Alternative Indicator Method
ASTM D 2240	Test Method for Rubber Products-Durometer Hardness
ASTM G 53	Operating Light and Water-Exposure Apparatus (Florescent UV-Condensation Type) for Exposure of Nonmetallic Materials.

Federal Test Method Standard No. 14 1	Paint, Varnish, Lacquer and Related Materials; Methods of Inspection, Sampling and Testing
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MATERIAL REQUIREMENTS

ASTM D 476	Specifications for Titanium Dioxide Pigments
Code of Federal Regulations	40 CFR Part 60, Appendix A 29 CFR Part 1910.1200
Fed. Spec. TT-B- 1325	Beads (Glass Spheres) Retroreflective
Fed. Spec. TT-P-1952D ,	Paint, Traffic and Airfield Marking, Waterborne
Commercial Item Description (CID) A-A-2886A	Paint, Traffic, Solvent Based
Federal Standard 595	Colors used in Government Procurement

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Federal **Aviation**
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